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# A Contribution to *Astragalus* sect. *Campylanthus* (Fabaceae) in Iran: Two New Species and a Diagnostic Key

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**ABSTRACT.** *Astragalus ghanbarianii* Maassoumi, Podlech & Zarre and *A. nervifolius* Maassoumi, Podlech & Zarre, two new species of *Astragalus* sect. *Campylanthus* Bunge (Fabaceae) from Iran, are described and illustrated. Because of the considerable changes in the delimitation of this section, a new diagnostic key to its species is presented. Moreover, *A. susianus* Boissier subsp. *sericeus* Tietz is reduced to synonymy of *A. chalaranthus* Boissier & Haussknecht.

**Key words:** *Astragalus*, Fabaceae, Iran, IUCN Red List, section *Campylanthus*.

The Iranian highlands, with about 1000 species of *Astragalus* L. (Fabaceae), are one of the most significant diversification centers of the genus (Podlech, 1999). In addition to the numerous endemic species, several natural groups recognized as sections are distributed exclusively in Iran. In the thorny *Astragalus* (Zarre, 2000), the monotypic section *Semnanenses* Zarre & Podlech (Zarre & Podlech, 2001a), together with section *Microphysa* Bunge and section *Campylanthus* Bunge (Bunge, 1868, 1869; Boissier, 1872; Tietz, 1988), are endemic to Iran. Species of both section *Campylanthus* and section *Microphysa* are distributed mainly in the Zagros Mountains of western Iran. Extensive support has been offered for the close

relationship between these sections (Tietz, 1988; Zarre, 2000; Podlech et al., 2001; Kazempour Osaloo et al., 2003, 2005), as well as for their possible close relation to section *Anthylloidei* DC. (Tietz & Zarre, 1994).

The Zagros Mountains is an important speciation center for several Irano-Turanian and Mesopotamian plant genera (Zohary, 1973). The southern part of this range is not well collected by botanists. Most species of *Astragalus* here are narrowly endemic (Tietz & Zarre, 1994; Podlech et al., 2001; Zarre & Podlech, 2001b).

The study of newly collected material in Iranian herbaria led to the discovery of the two new species described below for *Astragalus* sect. *Campylanthus*. Moreover, molecular studies using ITS sequences (Kazempour Osaloo et al., 2003, 2005) and this morphological study support the exclusion of *A. magistratus* Maassoumi, Ghahreman & Mozaffarian from section *Campylanthus*. *Astragalus ahmad-parsae* Maassoumi (Maassoumi, 1998) was overlooked in the *Flora Iranica* (Podlech et al., 2001), and the separation of *A. chalaranthus* Boissier & Haussknecht from *A. susianus* Boissier subsp. *sericeus* Tietz in that account is highly doubtful. All these findings support the necessity for providing a new key to the species of section *Campylanthus*.

## KEY TO THE SPECIES OF *ASTRAGALUS* SECT. *CAMPYLANTHUS* IN IRAN

- 1a. Inflorescences globose, heads overtopping the leaves, 10- to 20-flowered.
  - 2a. Calyx 16–23 mm long, teeth 11–17 mm long; heads 3–4.5 cm diam.; standard (13–)15–20 mm long, with elliptic to broadly elliptic limb. . . . . *A. tricholobus* DC. subsp. *tricholobus*
  - 2b. Calyx (10–)15–28 mm long, teeth 6–10 mm long; heads 1.5–3 cm diam.; standard 11–14(–18) mm long, with orbicular to broadly elliptic limb. . . . . *A. tricholobus* subsp. *hohenackeri* (Boissier) Tietz
- 1b. Inflorescences ovate to cylindrical, if globose then shorter than the leaves, often more than 20-flowered.
  - 3a. Fruiting calyx obviously inflated, 6–9 mm diam. . . . . *A. argyrostachyus* Boissier

- 3b. Fruiting calyx only slightly wider than flowering one, not inflated, 3–5 mm wide.
- 4a. Bracteoles always present; inflorescence  $\pm$  loose . . . . . *A. ecbatanus* Bunge
- 4b. Bracteoles absent or rarely present; inflorescences dense.
- 5a. Stipules membranous, hyaline; bracts membranous.
- 6a. Median stipules ca. 8 mm long; median leaves with 8 to 10 pairs of leaflets, up to  $11 \times 1-2$  mm; inflorescence globose to ovate, 2–3.5 cm diam. . . . . *A. ghanbarianii* Maassoumi, Podlech & Zarre
- 6b. Median stipules 12–15 mm long; median leaves with 5 to 7 pairs of leaflets; median leaflets  $12-18 \times 3-6$  mm; inflorescence cylindrical, longer.
- 7a. Median wings 15–16 mm long, the limb 9–10 mm long . . . . . *A. ahmad-parsae* Maassoumi
- 7b. Median wings 11–13 mm long, the limb 6–7.5 mm long . . . . .  
 . . . . . *A. nervifolius* Maassoumi, Podlech & Zarre
- 5b. Stipules chartaceous; bracts chartaceous (but membranous in *A. susianus*).
- 8a. Inflorescences 1.5–3 cm long, shorter than leaves, peduncles 0.3–1.5 cm long; leaflets of median leaves in 7 to 12 pairs.
- 9a. Stipules connate to each other at most up to the middle; rachis and leaflets spreading pubescent; bracts hyaline, median ones 6–11 mm long, often acuminate at tip, covered with short hairs only . . . . . *A. susianus* Boissier
- 9b. Stipules connate to each other at least from the middle up to the apex; rachis and leaflets appressed sericeous; bracts chartaceous, median ones 5–7 mm long, shortly acuminate, covered with short and long hairs . . . . . *A. chalaranthus* Boissier & Hausknecht
- 8b. Inflorescences 3–9 cm long, overtopping leaves, peduncles 2–15 cm long; leaflets of median leaves in 12 to 22 pairs.
- 10a. Median leaves with 12 to 22 leaflet pairs; bracts villous, their hairs up to 2 mm long . . . . . *A. campylanthus* Boissier
- 10b. Median leaves with 6 to 12 leaflet pairs; bracts with short appressed hairs up to 0.5 mm long or glabrous . . . . . *A. erinifolius* Pau

**1. *Astragalus ghanbarianii* Maassoumi, Podlech & Zarre, sp. nov.** TYPE: Iran. Fars: Jahrom, old rd. of Darab-Fasa, pass at 1200 m, 17 Apr. 2002, *G. Ghanbarian 78* (holotype, TARI). Figure 1.

Affinis *Astragalo ahmad-parsae* Maassoumi sed ab eo stipulis 4–10 mm (nec 12–15 mm) longis, foliolis usque ad 10- (nec 5- ad 7-) jugis, 1–2 mm (nec 3–6 mm) latis, pedunculo usque ad 1 cm (nec 1–3 cm) longo, racemo 2–3.5 cm (nec 5–7 cm) diam. et laminis alarum 6–7.5 mm (nec ca. 10 mm) longis; ab *A. susiano* Boissier calyce 12–15 mm (nec usque ad 11 mm) longo, dentibus 8–10 mm (nec usque ad 7 mm) longis, vexillo usque ad 13 mm (nec usque ad 10.5 mm) longo et foliolis usque ad 13 mm (nec usque ad 10 mm) longis differt.

Dwarf cushions, 20–50 cm tall, loosely branched at the base; indument exclusively white, on the calyx to 4 mm long, otherwise 0.1–2 mm; stems from a prostrate base ascending, 1–4 mm diam. in first year, growing 1–5 cm per year, below stipules densely appressed villous, gradually glabrescent; old stems covered by remainder of last year's thorns and stipules; stipules membranous, hyaline at margins, yellowish white, 4–10 mm, with 3 to 5 parallel veins, ovate-triangular, acuminate, 2–6 mm adnate to the petiole, otherwise 1–4 mm connate, densely furnished with long adpressed straight hairs, gradually glabrescent, ciliate at margins. Leaves 0.8–4.5 cm; rachises  $\pm$  remote, rigid, thick, densely covered by short spreading hairs, gradually glabrescent; petiole 0.4–1 cm (1/5–1/2 as long as the rachis); terminal spine 1–4 $\times$  longer than uppermost leaflet pair; leaflets 3 to 10 pairs, grayish green, strongly complicate,  $3-11 \times 1-2$  mm, linear to narrowly oblong or elliptic, acute at

tip, with a mucro  $< 0.3$  mm long, both surfaces densely to sparsely appressed pubescent. Inflorescence densely globose to ovoid, 2–3.5 cm diam., 20- to 30-flowered; peduncle 0.5–1 cm, densely villous; bracts membranous, yellow, 5–8 mm, outer ones ovate to broadly ovate, inner ones narrowly ovate to oblong or elliptic, acuminate at tip, densely appressed short pubescent, ciliate at margins; bracteoles absent; calyx papery, yellowish white, campanulate-tubular, 12–15 mm, 3–4 mm diam., with 10 to 15 parallel nerves, densely appressed pubescent; teeth 8–10 mm, ca. 2 $\times$  longer than the tube, filiform; petals pink to light purple (or brown when dried), claws of wings and the keel only basally adnate to stamen tube; standard 10–13 mm; limb orbicular, 6–9 mm diam., retuse at tip; wings 9–13 mm; limbs 6–7.5  $\times$  2–2.5 mm, obovate, obtuse at tip; auricle 0.7–1.3 mm; claw as long as the limb; corolla keel 8–12 mm, slightly shorter than wings; limbs 5–6  $\times$  2.5–3 mm, obovate-triangular, with  $\pm$  rectangular lower edge and straight upper edge; claw 5.5–7 mm; stamens as long as the keel, the free part 2–2.5 mm; ovary densely shortly sericeous, sessile; style 8–10 mm, pubescent at the base or up to lower 1/3. Mature fruits and seeds not seen.

*Distribution.* *Astragalus ghanbarianii* shares a similar, but somewhat more western, distribution pattern with *A. brevirhachis* Tietz & Zarre on the southern Zagros Mountains (Tietz & Zarre, 1993). The southern part of the Zagros Mountains is not well collected botanically, and it seems that the area may be an important diversification center for *Astragalus*.

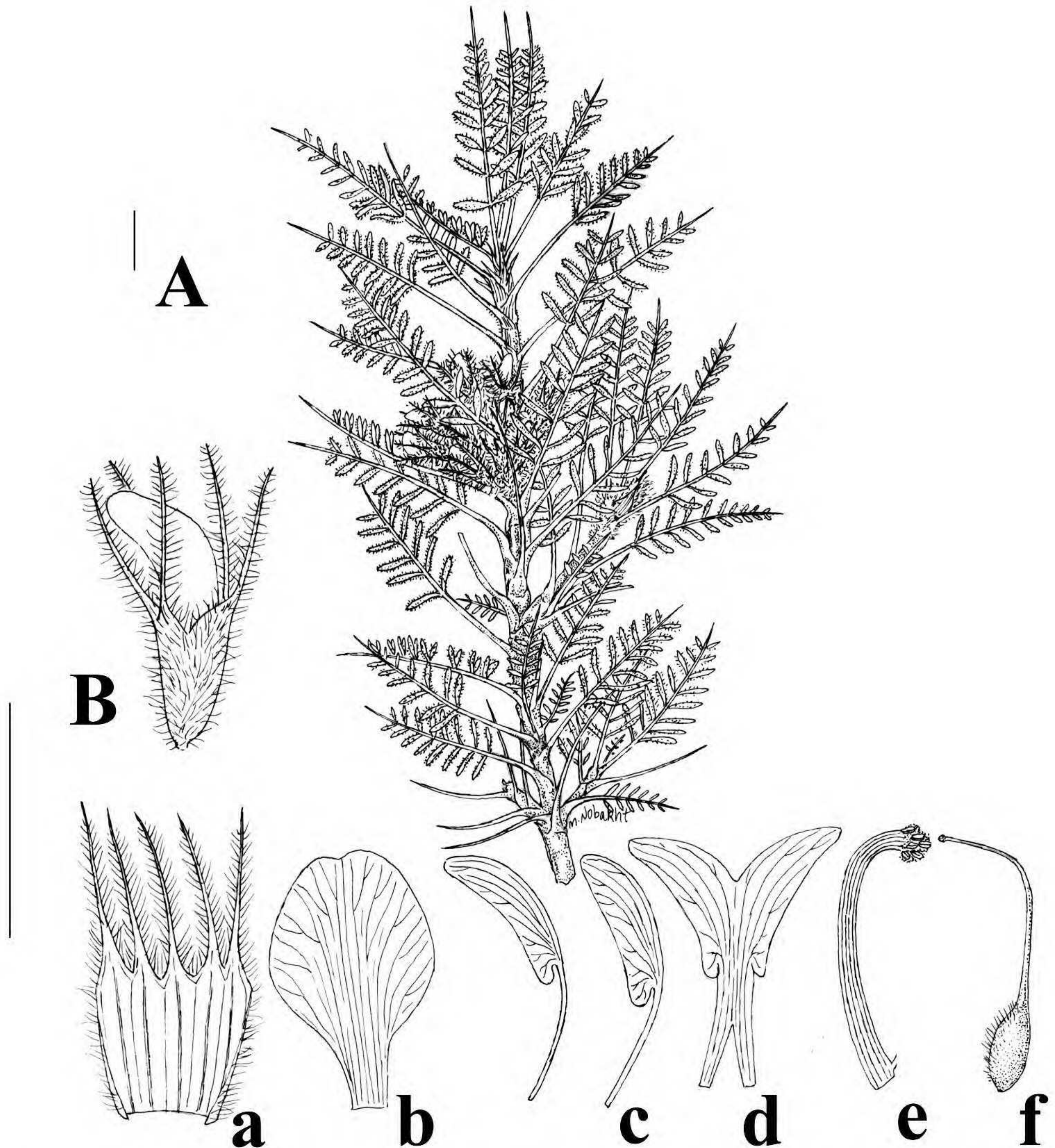


Figure 1. *Astragalus ghanbarianii* Maassoumi, Podlech & Zarre. —A. Flowering branch. —B. Flower. —a. Opened calyx. —b. Standard. —c. Wings. —d. Keel. —e. Staminal tube. —f. Ovary. Scale bars = 10 mm. Drawn from the holotype, G. Ghanbarian 78 (TARI), by A. Nobakht.

*IUCN Red List category.* Because of the paucity of collections, the species cannot be assessed for its conservation status and is considered Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001).

*Etymology.* The species epithet recognizes G. Ghanbarian, a researcher at the Research Center of Forests and Rangelands, Shiraz (Iran) and the collector of the plant.

*Species concept.* *Astragalus ghanbarianii* is the second species of section *Campylanthus* with standards longer than 12 mm. This character connects it to *A. ahmad-parsae* (Maassoumi, 1998), from which it differs by having linear to narrowly oblong or rarely

elliptic leaflets (vs. predominantly elliptic leaflets), racemes 2–3.5 mm long (vs. 5–7 cm), and smaller wing limbs (6–7.5 mm vs. ca. 10 mm long). The short and densely flowered inflorescences in *A. ghanbarianii* relate it to the core group of section *Campylanthus*, closest to *A. susianus* (see Tietz, 1988). The latter species has a shorter calyx (8–11 mm long) and petals (8–10.5 mm long) compared to *A. ghanbarianii*.

**2. *Astragalus nervifolius* Maassoumi, Podlech & Zarre, sp. nov.** TYPE: Iran. Khuzestan: Dehdez to Karun River, around Lirsiah, ca. 1000 m, 17 June 1995, V. Mozaffarian 74479 (holotype, TARI; isotype, M). Figure 2.

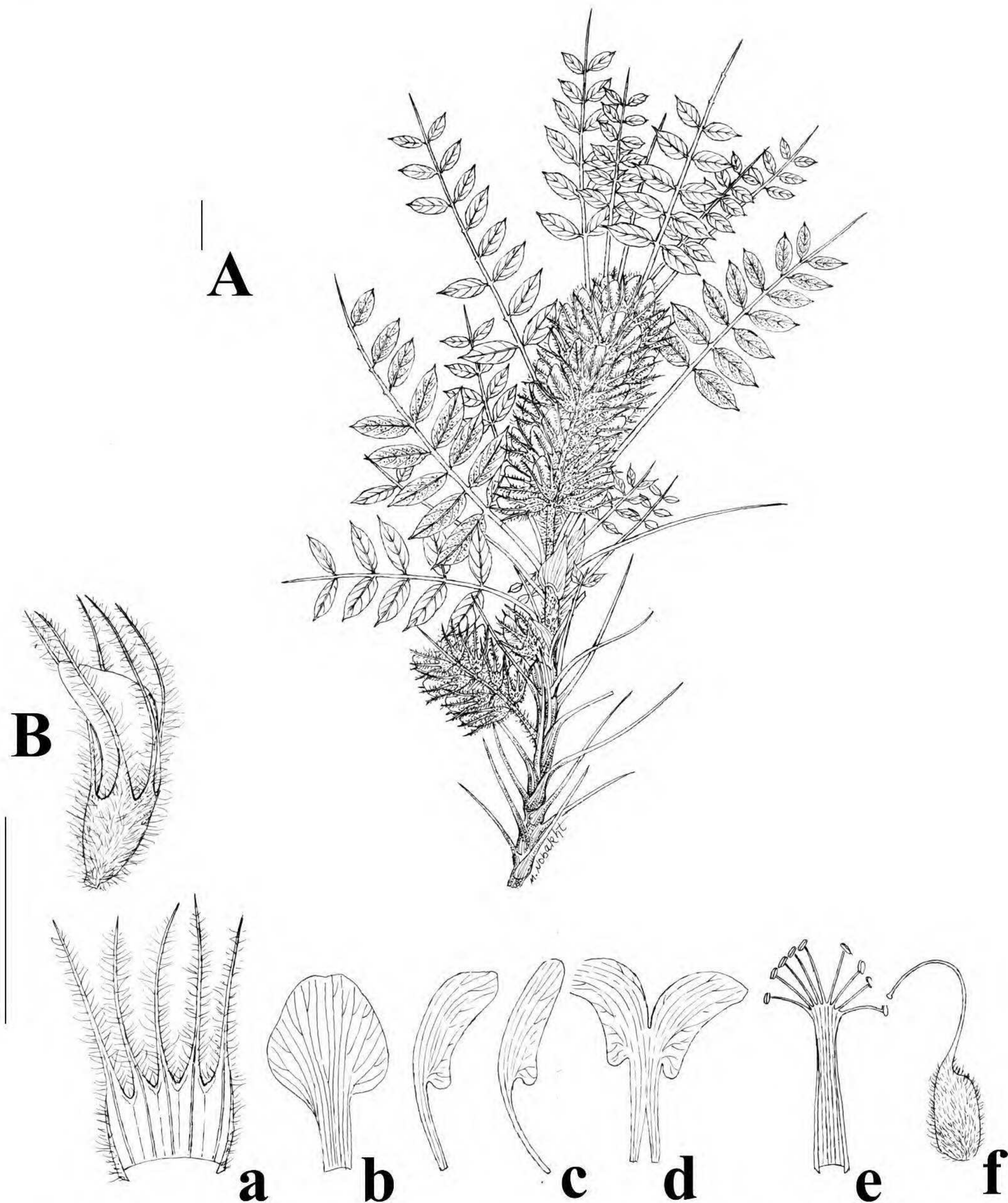


Figure 2. *Astragalus nervifolius* Maassoumi, Podlech & Zarre. —A. Flowering branch. —B. Flower. —a. Opened calyx. —b. Standard. —c. Wings. —d. Keel. —e. Staminal tube. —f. Ovary. Scale bars = 10 mm. Drawn from the holotype, V. Mozaffarian 74479 (TARI), by A. Nobakht.

Valde affinis *Astragalo ahmad-parsae* Maassoumi sed ab eo alis brevibus usque ad 13 mm (nec 13–16 mm) longis et laminis earum 6–7.5 mm (nec 9–10 mm) longis; ab *A. susiano* Boissier stipulis membranaceis (nec chartaceis) 7–13 mm (nec usque ad 9 mm) longis, foliolis 3- ad 7- (nec 5- ad 14-) jugis, remotis (nec congestis) 4–15 × 2–5 mm (nec 0.5–10 × 0.5–2.5 mm), planis (nec complicatis), longe mucronatis (nec breviter mucronulatis), prominenter nervosis, inflorescentis cylindratis 3–5 cm longis (nec globosis usque ovoides et usque ad 3 cm longis) et bracteis usque ad

15 mm (nec usque ad 11 mm) longis; ab *A. campylantho* Boissier stipulis membranaceis (nec chartaceis), foliolis 3- ad 7- (nec 8- ad 22-) jugis usque ad 15 mm (nec usque ad 10 mm) longis, remotis (nec congestis), planis (nec complicatis), longe mucronatis (nec breviter mucronulatis) et laminis carinae obtusis (nec acuminatis) differt.

Dwarf cushions, 20–50 cm tall, densely branched at base; hairs exclusively white, on the calyx up to 4 mm long, otherwise 0.1–2 mm; stem ascending, 1–

4 mm diam. in first year, growing 1–10 cm per year, below stipules densely appressed pubescent, gradually glabrescent; old stems covered by remainder of last year's thorns and stipules; stipules membranous, hyaline, yellowish white, 7–13 mm, with 5 to 11 parallel nerves, widely ovate-triangular, acute or acuminate at tip, 1.5–5 mm adnate to the petiole, otherwise 1–3 mm connate, sparsely furnished with long adpressed straight hairs, soon glabrescent. Leaves 0.8–8 cm; rachises  $\pm$  dense, rigid, thick, densely covered by tomentose hairs, gradually glabrescent; petiole 0.4–2.5 cm (1/4–1/2 as long as the rachis); terminal spine as long as the uppermost leaflet pair; leaflets 3 to 7 pairs, grayish green, flattened, 4–15  $\times$  2–5 mm, ovate to elliptic, obtuse at tip, with a mucro 1–2.5 mm long, both surfaces densely to sparsely tomentose. Inflorescence densely cylindrical to ovate, 3–5 cm, 2–2.5 mm diam., shorter than leaves, 40- to 100-flowered; peduncle 0.5–2.5 cm, densely villous; bracts membranous, yellow, 10–15 mm, outer ones ovate to elliptic, inner ones narrowly ovate to oblong or linear, acuminate at tip, sparsely pubescent to glabrous, ciliate at margins; bracteoles absent; calyx papery, yellowish white, campanulate-tubular, 12–15 mm, 3–4 mm diam., with 10 to 15 parallel veins, densely appressed pubescent; teeth 8–10 mm, ca. 2 $\times$  longer than the tube, filiform; petals pink to light purple, claws of wings and the keel only basally adnate to stamen tube; corolla standard 12–13 mm; limb orbicular, 6–9 mm diam., retuse at apex; corolla wings 11–13 mm; limbs 6–7.5  $\times$  2–2.5 mm, obovate, obtuse at tip; auricle 0.7–1.3 mm; claw as long as the limb; corolla keel 10–12 mm, slightly shorter than wings; limb 5–6 mm, 2.5–3 mm deep, obovate-triangular, with  $\pm$  rectangular lower edge and straight upper edge; claw 5.5–7 mm; stamens as long as keel, free part 2–2.5 mm; ovary densely shortly sericeous, sessile; style 8–10 mm, pubescent at base or up to lower 1/3. Mature fruits and seeds not seen.

*Distribution.* *Astragalus nervifolius* is distributed in the southern part of the Zagros Mountains along the border of Chahar-Mahal and Khuzestan provinces.

*IUCN Red List category.* Because of the paucity of collections, the species cannot be assessed for its conservation status and is considered Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001).

*Species concept.* *Astragalus nervifolius* possesses large petals similar to *A. ghanbarianii* and can therefore be compared with *A. ahmad-parsae* (see above). Ovate to elliptic leaves with prominent reticulate venation (for which the specific epithet is

selected) that are characteristic for this species separate it from *A. ghanbarianii* and relate it to *A. ahmad-parsae*. However, *A. nervifolius* differs principally from *A. ahmad-parsae* in the size of petals, which are 11–13 mm long (vs. 13–16 mm long in *A. ahmad-parsae*) with the wing limbs 6–7.5 mm (vs. 9–10 mm long). *Astragalus nervifolius* has cylindrical inflorescences that are shorter than the leaves, a character that it shares with *A. susianus* and *A. chalaranthus* (see Tietz, 1988). *Astragalus nervifolius* differs from both of these species, however, by its large bracts (10–15 mm vs. 9–12 mm long) and stipules (7–13 mm vs. 6–9 mm long).

#### CIRCUMSCRIPTION OF *ASTRAGALUS SUSIANUS*

Tietz (1988) recognized two subspecies in *Astragalus susianus*: subspecies *susianus* was said to have leaflets with spreading hairs, whereas those of subspecies *sericeus* have appressed hairs. Moreover, the bracts are hyaline but large (6–11 mm long) in subspecies *susianus*, whereas they are chartaceous and smaller (5–7 mm long) in subspecies *sericeus*. *Astragalus susianus* differs from *A. chalaranthus* primarily by having the stipules connate up to the middle instead of up to the apex. Interestingly, the distribution of *A. chalaranthus* overlaps significantly with that of *A. susianus* subsp. *sericeus*. Furthermore, the presence of hyaline and short bracts in both taxa supports their union. Therefore, *A. susianus* subsp. *sericeus* is reduced herein to synonymy of *A. chalaranthus*.

***Astragalus chalaranthus*** Boissier & Haussknecht, in Boissier, Fl. Orientalis 2: 390. 1872. TYPE: [Iran.] SW Persia, Mt. Kuh Sawers, Eschker, 8000 ft., July 1868, *Haussknecht s.n.* (holotype, G-BOIS).

*Astragalus susianus* Boissier subsp. *sericeus* Tietz, in Mitt. Bot. Staatssamml. München 27: 174. 1988. Syn. nov. TYPE: Iran. Fars: 5 km E of Mian Kotal, 80 km W of Shiraz, 2200 m, 28 June 1964, *M. L. Grant 15868* (holotype, W).

*Acknowledgments.* We are grateful to Ihsan Al-Shehbaz (MO) for his editing and critical review of the manuscript. We are indebted to M. Nobakht (TARI) for preparing the illustrations of the new species. The revision of *Astragalus* sect. *Campylanthus* was prepared as part of a project supported by the Research Council of Tehran University to Shahin Zarre; additional funding from Alexander von Humboldt Stiftung supported Shahin Zarre's travel to study the type material in Munich.

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